

is interesting. My observations of the satellites of this planet are not yet discussed, but they indicate that Bessel's value of the mass of *Saturn* is nearly correct. I think that Le Verrier made some error in the perturbations of *Jupiter* and *Saturn*, by which he got some of his coefficients too large, and then, in adjusting his theory to fit the observations, he was led to diminish the mass of *Saturn*. Mr. G. W. Hill is at work on the complicated theory of *Jupiter* and *Saturn*, and in the course of two or three years we may expect his results.

In the theory of *Hyperion* I think that I have got hold of an interesting motion of the line of apsides; the observations of this satellite hitherto made are so clustered about the elongations that the elements remain somewhat uncertain, but after two years I shall be able to follow all around the planet this faint object.

*Naval Observatory, Washington,
1879, February 18.*

An apparently New Variable Star. By J. L. E. Dreyer, Esq.

On March 8, when observing the red star Schj. 109 (Lal. 16770 = Weisse I, 8^h625 = Schj. 3122), I remarked a very conspicuous star of the 9.0 mag. *n.p.* it, which is not in the *Durchmusterung* nor in Bond's *Zones* 46 and 47, while it occurs in zone 48 as a * 11 mag. As the Harvard *Zones* contain stars down to the 12-13 mag. (except in very crowded places, of which this is not one) or on Argelander's scale to about the 11th mag., the star *n.p.* the red one appears to be variable. It is 16^s7 p. and 103''^o *n.* of Schj. 109, its position being for 1855

$$\begin{array}{rccc} \text{h} & \text{m} & \text{s} & \\ 8 & 23 & 56\cdot3 & \\ & & & + 0^{\circ} 20\cdot3. \end{array}$$

The only place where I have found this star mentioned, besides Harvard Zone 48, is the Munich Catalogue of Stars, between +3° and -3° Decl., where it is stated to be of the 10th mag., and the star *s.f.* of the 9th. The latter is of the 8.5 mag. in the *Durchmusterung*.

*The Observatory, Dunsink,
April 1879.*

Observations of Absorbing Vapours upon the Sun.

By Professor E. Leopold Trouvelot.

In a letter published in vol. xxxiii., page 63, of the *Monthly Notices of the Royal Astronomical Society*, November 1872, Mr. Chacornac gives an account of an interesting observation of his, entitled, "On a Volcanic Appearance in the Sun." Although I do not fully understand what Mr. Chacornac means

by "Une flamme crateriforme représentant un orifice volcanique en ignition," yet, as one of my observations seems to have some relation with his own, there may be a certain interest in recording it.

As I was observing the Sun with the spectroscope at the Harvard College Observatory on the morning of July 28, 1872, at 9^h 0^m, and sweeping its surface with the narrow slit of the instrument, my attention was attracted by a large black spot crossing obliquely the C line, and projecting on each side upon the spectrum. By conveniently adjusting the spectroscope, it was very easy to recognise its position, form, and size. It was situated on the southern hemisphere of the Sun, in the vicinity of a very large sunspot which was on its second return, and then not far from the east limb. This remarkable object, which very nearly formed a straight line, was very narrow and slender; but much wider towards its southern extremity, from whence it gradually decreased as it advanced northward, until it terminated on this side in a very acute extremity. From its southern end to about half its length it projected upon the spectrum on both sides of the C line, to a distance equal to about three or four times the width of this line. Its length was considerable. It began at a small distance to the south-west of the large sunspot, and thence, inclining to the west, it advanced northwards towards the centre of the Sun, in the vicinity of which it terminated; the angle it subtended being equal at least to one-sixth of the diameter of the Sun.

As soon as this observation was completed, the same part of the Sun was observed telescopically with different power eyepieces, and scrutinised with attention; but, to my surprise, I could not see the least trace of a spot or mark indicating the cause of the phenomenon so prominent on the C line. Even no difference was noticed in the granulations covering that part of the Sun from whence the absorption proceeded. However, the phenomenon had not disappeared during the time I had removed the spectroscope, as this instrument, having been replaced, continued to show the black spot sharply defined on the spectrum.

On July 29, at 9^h 0^m, the slit of the spectroscope was again directed in the vicinity of the large southern sunspot, and soon the dark absorbing spot seen the day before was found in nearly the same place. However, its size was reduced, it was not so black and sharp, and it no longer projected on the spectrum, its absorbing quality having evidently diminished. This part of the Sun being also examined with the telescope, nothing unusual was noticed.

However, Mr. Chacornac had observed the Sun on the same day, at 9^h 0^m A.M., or, if we take into account the difference of longitude, about 5^h 30^m before I observed it in Cambridge; and then, according to his expressions, he saw, "Une flamme crateriforme représentant un orifice volcanique en ignition. . . . d'une

³teinte bleuâtre nettement décidée . . . et soustendant un angle d'environ un septième du diamètre solaire."

As the French astronomer saw this "flamme" with the telescope 18^h 30^m after my first observation, and 5^h 30^m before the second, it might be inferred that the phenomenon had increased, and was in a particular state of visibility at the moment of his observations, since I could not, with the telescope alone, see the least traces of it before or after his observations. It seems difficult to admit that Mr. Chacornac and I have been observing a different phenomenon, since the position of this object, so near the large sunspot, could not be mistaken; and besides, by its unusual size, it is not very likely that another of such length should have formed in the same vicinity in a few hours.

For the explanation of this curious phenomenon it does not seem necessary to call forth something analogous to Ulloa's hole, as Mr. Chacornac has done, since it seems rather more simple to think that it was due to some hydrogenated vapours strongly absorbing the rays of the Sun, and which had been expelled from the interior of the large sunspot in the vicinity, as some of my observations indicate, and as will be shown presently.

May 16, 1872. The Sun having been examined with the spectroscope, several black spots, darker than the C line, made their appearance on this line, and projected on the spectrum towards the side of less refrangibility. These objects issued from an area of the Sun enclosed between a group of sunspots then very near the western limb.

July 17, 1872. A very dark spot was seen crossing the C line; no trace of it was seen on D³ or on any other part of the spectrum.

April 16, 1873, 9^h o^m A.M. A strong dark spot was observed on the C line; it issued from a part of the Sun situated between two groups of sunspots not very far from the western limb. By slowly moving the slit the complicated form of this object showed itself as it passed over it. It was very irregular, curved, with wider and darker places, which sometimes projected upon the spectrum, either on one or both sides of the C line. Its length was considerable, as it occupied almost the whole space between the two groups of sunspots, which were quite distant. When observed with the telescope, no traces of it were found.

September 22, 1873, 9^h 25^m A.M. A very curious group of four small dark spots, disposed in a lozenge shape, were seen projecting on the spectrum on the red side of the C line, and at some distance from it. The furthest of these spots was upon the fine line 690 of Kirchhoff's maps. These spots appeared entirely disconnected from the C line, and perfectly independent of each other. They were in rapid motion, and were seen gradually moving together towards the C line, which they reached in less than five minutes; while at the same time they diminished gradually in size and in depth of tint until they vanished.

September 28, 1873. A similar phenomenon was observed in the south-east of two large groups of sunspots.

October 29, 1873. A sunspot was crossing the western limb, when it was observed that the spectrum of the chromosphere above it was vacant and replaced by a dark spot projecting outside of the C line.

November 5, 1873, 10^h 30^m. While observing the surface of the Sun between two sunspots situated at some distance from the west limb, a large black spot appeared upon the C line and projected on each side upon the spectrum, but to a greater distance on the violet side, where it extended five or six times the width of this line. Its form was that of the letter C. This part of the Sun being examined with the telescope, a bluish kind of a spot, much diffused in outlines, was seen where the spot on the C line appeared. At 2^h 0^m P.M. the spot of absorption was no more to be seen, but in its very place a small group of three sunspots had formed since the observation made in the morning.

November 6, 1873, 10^h 30^m. A spot of absorption issuing from the vicinity of the small group of sunspots formed the day before was observed on the C line. With the telescope faint bluish spots could be seen on this part of the Sun. This spot of absorption, so prominent upon the C line, was not visible on the D lines, or on any other seen in the field of view. This spot was quite large, but narrow and branching off in several places. While sweeping along it with the slit, at one point near its eastern extremity the black spot, then projecting towards the red end, passed suddenly on the violet side of the C line, where it extended much further than it did on the other side. The following day it was found that where the absorbing vapour had been observed a long row of small sunspots had formed in its place, which united the two large spots by a dozen or more smaller ones.

December 24, 1873. Four small elongated dark spots, almost united end to end, were seen projected on the spectrum near the C line, on the side of greater refrangibility, where they occupied about three-fourths the width of the spectrum. They formed almost a straight line, which was a little inclined to the C line, its nearest extremity being separated from it by an interval about twice the width of this line, while the furthest was four or five times this distance. These spots were not in apparent communication with the C line.

May 30, 1874. A sunspot was passing the west limb; a spot of absorption was observed above it on the C line in place of the brilliant spectrum of the chromosphere. A similar phenomenon to that observed on October 29, 1873.

August 26, 1874, 9^h 15^m. While I was observing a moderate sized sunspot with the telescope, a small bluish cloudlike form was seen issuing from this spot, and, taking a westerly course, it moved rapidly away, while at the same time it dilated considerably, until, becoming more and more diffused, it gradually became invisible.

1878
378
378

June 1, 1875. On the morning of that day I observed with the telescope a very large elongated bluish spot, having diffused edges, in the north-east of a group of sunspots then very active and in process of formation, and which became so conspicuous the following day.

December 12, 1875, 12^h 30^m. While observing a sunspot under a brilliant facula, a long trail of bluish vapours issued from the northern corner of this spot, and had its direction north-east.

September 4, 1877. Several spots of absorption were observed on the C line, in the vicinity of a group of sunspots then in great activity; the C line being reversed in many places by brilliant faculae. One of the spots of absorption was quite extended, and, by moving the slit along it, it projected sometimes on one side of the C line, sometimes on the other, or on both. The group of sunspots close to the place where these absorbing vapours were issuing was very active; and at 1^h 30^m a sunspot, which at 9^h 0^m appeared as a veiled spot, had made its appearance. The following day, at 9^h 0^m, several spots of absorption intermingled with brilliant faculae reversing the C line were observed in the same place where they had been seen on the 4th. One of these spots was quite large and prominent, and close to the sunspot formed the afternoon before.

March 15, 1878. Quite a large spot of absorption was observed on the C line, and projected on each side upon the spectrum. This spot was issuing from the vicinity of a group of spots, being between it and a veiled spot situated about the centre of the Sun. This absorbing spot was visible on no other line in the spectrum except the C line.

May 26, 1878. In the vicinity of a large and important group of sunspots, situated in the east of the Sun, the C line was partially reversed in several places, and many dark absorbing spots were seen projecting on both sides of this line.

May 27, 1878. A very interesting phenomenon was observed on the preceding sunspot of the large group, where the spots of absorption were observed the day before. The phenomenon was the more remarkable because the spot on which it took place could be easily compared with the following one of the group, at a small distance from it. The umbra of the preceding sunspot was invaded by a bluish or purplish kind of a fog, which totally obscured its contour, and rendered the interior of the penumbra very diffused and indistinct. The phenomenon was so characteristic that I at first thought the focussing was bad, and tried to readjust it; but it was soon found that such was not the case, as the umbra of the following spot was admirably well defined, while the foggy appearance remained the same on the preceding spot. The spectrum of this spot was much darker than that of the following, and the C line was much more swollen on it than on the other. The phenomenon continued about the same for several days, and it was only on June 1 that both umbræ and their spectra

appeared the same; this change corresponded to a decrease of size of the preceding spot. On May 28 the C line was reversed on several places in the vicinity of this spot, and several dark absorbing spots were seen projected on both sides of the C line.

It is seen from these observations that on several occasions the dark spots seen on and about the C line preceded by a few hours or even days the opening of sunspots, as if they were, like the faculae, the precursors of solar spots. The fact that these dark spectral spots were observed in every case in the vicinity of solar spots in full activity, or upon the very umbræ of such spots, is sufficient, it seems, to prove that absorbing vapours, just as well as intensely luminous gases, are ejected from the interior of the Sun through the opening of the solar spots, even if the direct observations had not shown these vapours issuing from the spots and moving away from them on the surface of the Sun.

Cambridge, U.S., January 12, 1879.

Ephemeris for Physical Observations of Jupiter, 1879. By A. Marth, Esq.

G.M.T. 1879.	Angle of Position of Jupiter's Axis.	Longitude of Meridian directed to the Earth. Diff.	Latitude of Earth Sun above Jupiter's Equator.	Annual Parallax.	Equat. Diam.	Greatest Phase.	Corr. of Long.		
January 20	335° 63	145° 66	+ 1° 12	+ 0° 71	- 11° 43	38° 30	0° 380	+ 0° 57	
25	335° 56	178° 46	4352° 80	1° 16	0° 73	11° 57	38° 89	·396	·58
30	335° 49	211° 32	2° 86	1° 20	0° 75	11° 65	39° 50	·407	·59
			2° 93						
February 4	335° 44	244° 25	4353° 00	+ 1° 24	+ 0° 78	- 11° 67	40° 13	·415	+ 0° 59
9	335° 39	277° 25	3° 07	1° 28	0° 80	11° 61	40° 78	·417	·59
14	335° 36	310° 32	3° 14	1° 32	0° 82	11° 48	41° 45	·415	·57
19	335° 33	343° 46	3° 21	1° 35	0° 85	11° 28	42° 13	·406	·55
24	335° 31	16° 67	3° 27	1° 38	0° 87	10° 99	42° 81	·393	·53
29	335° 30	49° 94	3° 34	1° 41	0° 89	10° 63	43° 50	·373	·49
July 4	335° 30	83° 28	4353° 41	+ 1° 43	+ 0° 92	- 10° 19	44° 18	·348	+ 0° 45
9	335° 31	116° 69	3° 47	1° 46	0° 94	9° 66	44° 85	·311	·40
14	335° 32	150° 16	3° 53	1° 48	0° 96	9° 06	45° 50	·284	·36
19	335° 34	183° 69	3° 58	1° 49	0° 98	8° 37	46° 13	·246	·31
24	335° 38	217° 27	3° 63	1° 50	1° 01	7° 61	46° 72	·206	·25
29	335° 42	250° 90	3° 66	1° 51	1° 03	6° 78	47° 26	·165	·20